Future plans in US Flight missions: using laser remote sensing for climate science observations

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Laser Remote Sensing provides critical climate science observations necessary to better measure, understand, model and predict the Earth's water, carbon and energy cycles. Laser Remote Sensing applications for studying the Earth and other planets include three dimensional mapping of surface topography, canopy height and density, atmospheric measurement of aerosols and trace gases, plume and cloud profiles, and winds measurements. Beyond the science, data from these missions will produce new data products and applications for a multitude of end users including policy makers and urban planners on local, national and global levels.

NASA Missions in formulation including Ice, Cloud, and land Elevation Satellite (ICESat 2) and the Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI), and future missions such as the Active Sensing of CO2 Emissions over Nights, Days and Seasons (ASCENDS), will incorporate the next generation of LIght Detection And Ranging (lidar) instruments to measure changes in the surface elevation of the ice, quantify ecosystem carbon storage due to biomass and its change, and provide critical data on CO_2 in the atmosphere. Goddard's plans for these instruments and potential uses for the resulting data are described below.

For the ICESat 2 mission, GSFC is developing a micro-pulse multi-beam lidar. This instrument will provide improved ice elevation estimates over high slope and very rough areas and result in improved lead detection for sea ice estimates. Data about the sea ice and predictions related to sea levels will continue to help inform urban planners as the changes in the polar ice accelerate.

DESDynI is planned to be launched in 2017 and includes both lidar and radar instruments. GSFC is responsible for the lidar portion of the DESDynI mission and is developing a scanning laser altimeter that will measure the Earth's topography, the structure of tree canopies, biomass, and surface roughness. The DESDynI lidar will also measure and predict the response of ice masses to climate change and impact on sea level.

Data from the lidar will ultimately be fused with radar data products with heretofore unseen results and applications. The 3-D structure of forests is critical to understanding the impact of land use and associated landscape changes on the habitat of life forms and consequently on their biodiversity.

Lidar instruments are also under development to measure trace gases in the atmospheric such as CO2 and methane. GSFC is developing an active measurement approach to determine the CO2 column density and surface pressure for the proposed ASCENDS mission. The objective of this approach is to produce data on the amounts of anthropogenic and organic CO2 in the atmosphere with sufficient accuracy to meet the needs of target users including state, federal and international users as well as policy-related legislative, regulatory, and voluntary carbon-related management groups local to international interests.

In summary, NASA will continue to rely on laser remote sensing for critical climate science observations and is committed to the development of the next generation of lidar instruments for a range of applications.